Proceedings of the Iowa Academy of Science

Volume 42 | Annual Issue Article 94

1935

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STRUCTURAL FEATURES OF THE BRAIN OF LEPIDOSTEUS

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The brain of the garpike presents several peculiarities which deviate considerably from the general structure of the typical fish brain, concerning which there is a marked difference of opinion amongst the various investigators or about which very little is known. The present paper presents a preliminary report about some of the interesting features of the brain of Lepidosteus. In the following discussion special attention will be given to the meninges and their relationship to the brain and to the outpushings of the diencephalon and their relationship to each other.

MENINGES

The outpushings of the diencephalon and the myelencephalic gland are so intimately related to the meninges that it is necessary to study the membranes surrounding the brain. Following a survey of the literature, it becomes evident that the study of the meninges of Lepidosteus leads to a field almost untouched by previous workers.

It seems evident from the study of sagittal and transverse sections that the endorachis and the primitive meninx are present in Lepidosteus. Unlike higher forms, there is no arachnoid tissue in Lepidosteus.

The outermost pigmented endorachis clings closely to the skull, and invests the brain cavity entirely. This membrane bridges over all of the sulci of the brain except that of the diencephalon (Fig. 1). In front of the optic lobes, the dura mater (endorachis) dips down for a short distance making a tight fold which does not reach the brain, then turns cephalad and overlaps the posterior part of the cerebrum. It then reverts again caudoventrally and follows the contour of the posterior wall of the cerebrum, to a point where it comes in contact with the primitive meninx just in front of the habenula. At this point, the endorachis turns back on itself passing between its down-fold and the cerebrum, then passes forward over the telencephalon.

As a matter of fact the endorachis in the region of the diencephalon dips down on all sides following closely the margin of

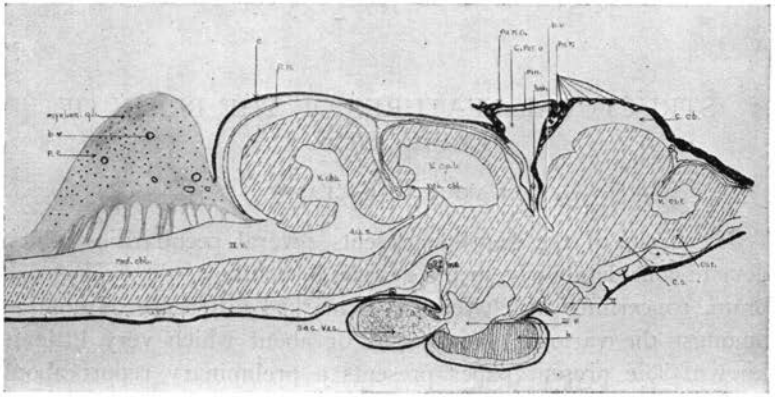

Fig. 1. A diagramatic sketch of the sagittal view of the brain of Lepidosteus platostomus, 60 c. length. x 15

Abbreviations

aq. s.	aqueduct of sylvius
b. v.	blood vessel
c. cb.	cavity of cerebrum
c. par. o.	cavity of parietal organ
c. s.	corpus striatum
e.	endorachis
IV. V.	fourth ventricle
h.	hypophysis
hab.	habenula
mb.	mammillary body
med. obl.	medulla oblongata
myelen. gl.	myelencephalic gland
olf.	olfactory lobe
ll.	optic nerve
par.	paraphysis
par. o.	parietal organ
p. c.	pigmented cell
pin.	pinealis
p. m.	primitive meninx
sac. vas.	saccus vasculosa
III v.	third ventricle
val. cbl.	valvula of cerebellum
v. cbl.	ventricle of cerebellum
v. opl.	ventricle of optic lobes
v. olf.	ventricle of olfactory lobes

the balloon-like sac, with the lower, narrower end almost completely encircling the habenula (except posteriorly); the anterior wall being the fold just mentioned, follows the contour of the cerebrum, while the posterior wall is the short fold described in front of the optic lobes. It must be remembered that the walls of these several folds are close together, so that they hang down from the roof like a solid membrane. The balloon-like sac, enclosed in the endorachis, constitutes the dorsal sac, or parietal organ of various authors. Lateral to this dorsal sac the endorachis again dips down on each side to form the lateral sacs, and then continues round the ventral side of the diencephalon, so that it is possible to speak of four sacs in this region, a dorsal sac, the parietal organ, a ventral sac, inclosing the diencephalon and two lateral sacs (Figs. 2, 3).

The endorachis arches forward over the cerebrum and olfactory lobes. The septum which lies between the lobes of the corpora striata is not an invagination of the endorachis but instead, the modified median walls of the cerebral lobes.

The primitive meninx follows the irregularities of the surface of the brain and sends prolongations into its sulci (Fig. 1). It

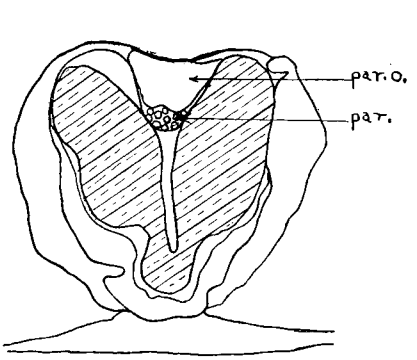

Fig. 2

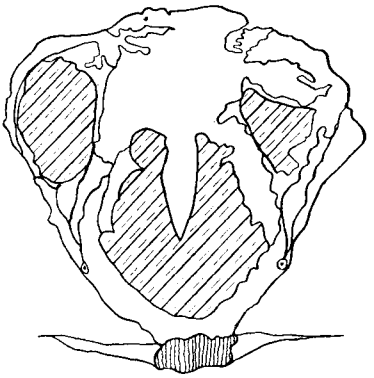

Fig. 3

Fig. 2. Cross-section through the most posterior part of the cerebrum. Lepidosteus platostomus, 20 cm. length. x20

ABBREVIATIONS

par. o.....parietal organ par.....paraphysis

Fig. 3. This figure illustrates the four membranous sacs of the diencephalon. Lepidosteus platostomus, 20 cm. length. x20

seems to be an incomplete membrane, unrecognizable and apparently lacking over the cerebrum. If the primitive meninx is present over the cerebrum, it must be so intimately attached to the roof as to be indistinct.

The myelencephalon gland is the only part of the brain that is not covered by the membranes. Chandler (1911) describes the gland as a lymphoid structure, thus concluding that it is a development of the pial covering.

OUTPUSHINGS OF THE DIENCEPHALON

That the upper part of the diencephalon has been so differently interpreted is not surprising since the outpushings are so intimately related to the meninges of the brain that when the latter are removed the organs are destroyed.

The roof of the diencephalon of Lepidosteus presents an interesting variation from the usual type brain. In related forms the outpushings are free and independent but in Lepidosteus the parietal organ engulfs the pinealis. A complete embryological study has not been made, however, material of sixteen and eighteen millimeter stages were available. In these stages the two bodies are distinct and separate. It is not known how the pinealis becomes invested in the parietal organ. A logical explanation would be that the pinealis extends over the parietal organ and sinks down, as it were, into its dorsal wall which arches over the pinealis, finally anastomosing to enclose it.

The pinealis, tubular in form, arises from the bi-lobed habenula,

extends upward and slightly posterior to a point about one millimeter higher than the optic lobes. It then turns cephalad, expanding in a rounded-leaf-shaped organ which extends the entire length of the roof of the parietal organ. The pinealis is intimately attached to the posterior and upper wall of the parietal organ but does not extend in the cavity of this expanded sac. The cavity of the pinealis is not evident in strained material, however, if a freshly dissected brain is immersed in a liquid it puffs up revealing the cavity.

The parietal organ is a large ballon-shaped sac protruding from the roof of the diencephalon just in front of the pinealis (Fig. 1). It overlaps the anterior part of the optic lobes behind and the posterior part of the cerebrum in front.

The paraphysis, although not an evagination from the wall of the diencephalon, is in intimate relationship to the outpushings of this region. The posterior and upper wall of the cerebrum is thickened, presenting numerous evaginations to form a network of tubules. These constitute the paraphysis. It is so intimately related to the thin wall and the meninges as to appear as a part of them.

CONCLUSIONS

1. There are only two meningeal membranes in Lepidosteus. The endorachis invests the brain cavity completely passing over each sulcus, while the primitive meninx follows the contour of each sulcus. The latter loses its identity over the cerebrum, which indicates that it is either incomplete in this region, or else so intimately related with the thin membranous roof of the cerebrum as to be unrecognizable.

2. The posterior and upper wall of the cerebrum is thickened, presenting numerous evaginations to form a network of tubules. These tubules constitute the paraphysis.

3. The pinealis is in the shape of a rounded leaf with the petiole bent downward. The petiole is engulfed in the posterior wall of the parietal organ, while the blade portion is intimately joined to the upper surface. The pinealis does not extend into the cavity of the parietal organ.

4. The parietal organ is a large balloon-like sac, protruding from the roof of the diencephalon just in front of the pinealis.

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